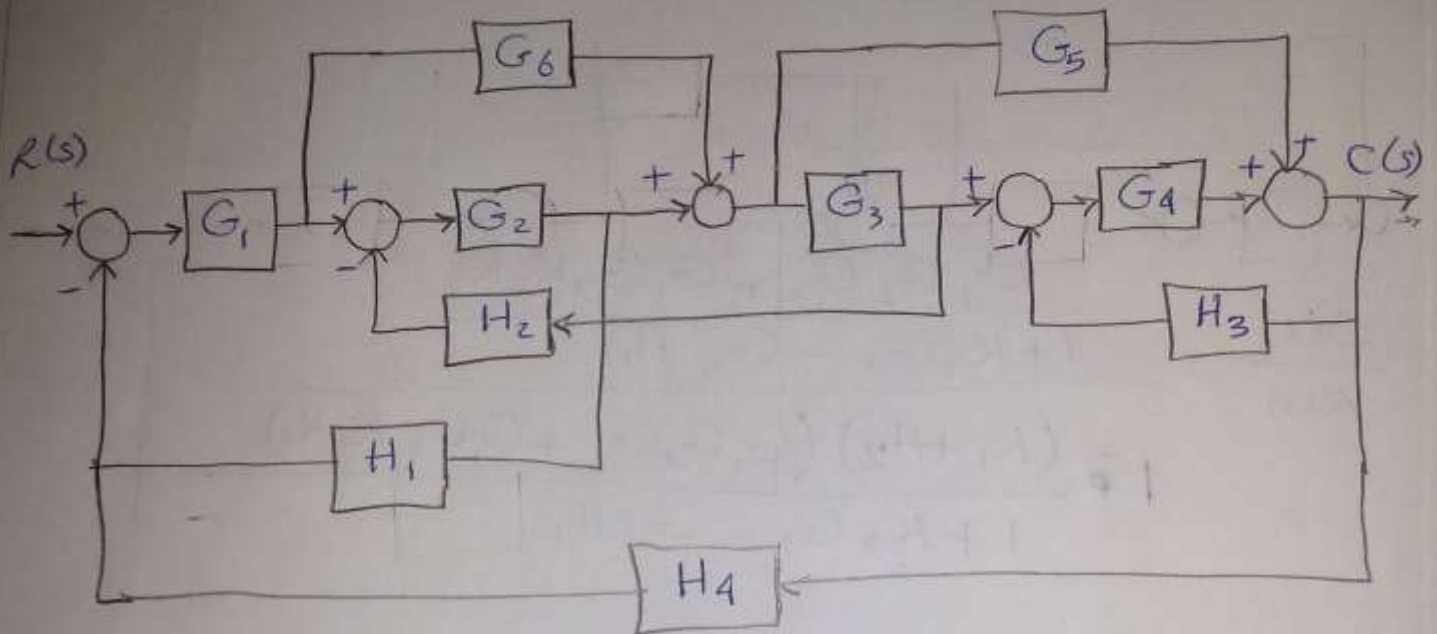
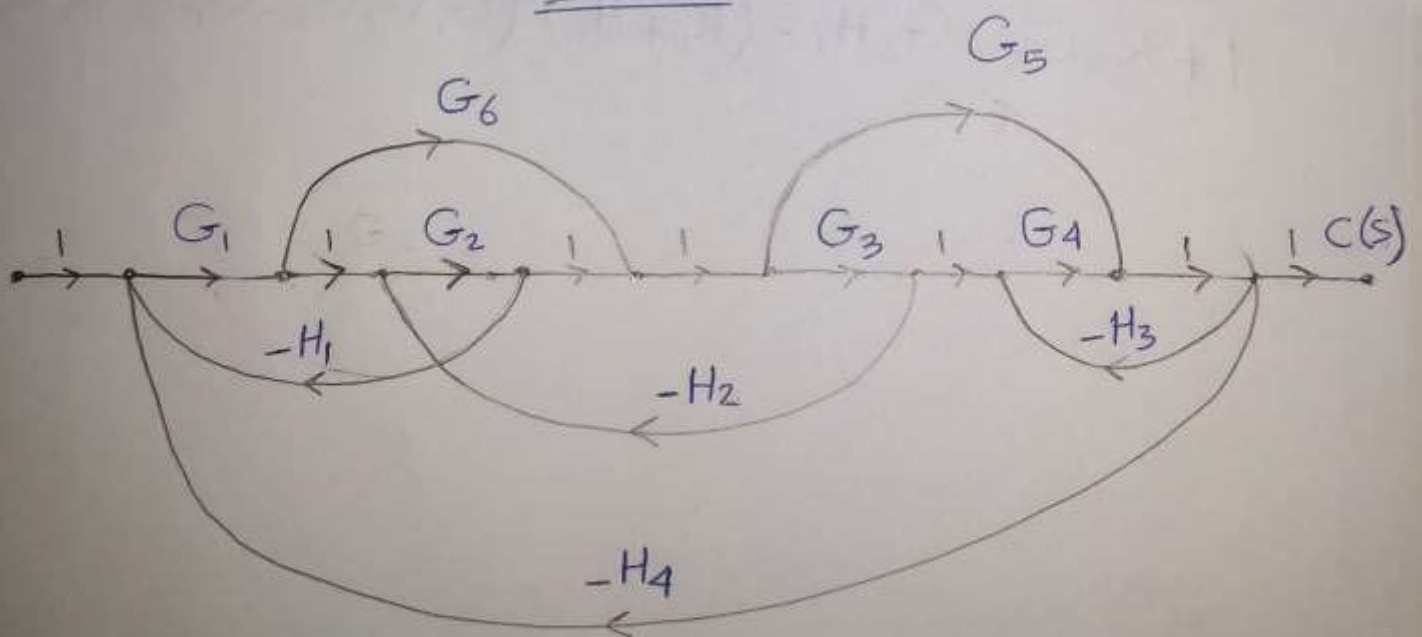


Sheet 5

1) Use Mason's Gain Formula to determine the transfer function $C(s)/R(s)$ for the system given:-



Sol



Forward Paths

$$P_1 = G_1 G_2 G_3 G_4$$

$$P_2 = G_1 G_6 G_3 G_4$$

$$P_3 = G_1 G_6 G_5$$

$$P_4 = G_1 G_2 G_5$$

Loops

$$L_1 = -G_1 G_2 H_1$$

$$L_2 = -G_4 H_3$$

$$L_3 = -G_2 G_3 H_2$$

$$L_4 = -G_1 G_2 G_3 G_4 H_4$$

$$L_5 = -G_1 G_6 G_3 G_4 H_4$$

$$L_6 = -G_1 G_6 G_5 H_4$$

* Non touching loops

$$L_{12} = G_1 G_2 G_4 H_1 H_3$$

$$L_{23} = G_2 G_3 G_4 H_2 H_3$$

$$\Delta = 1 - \sum \text{all loops} + \sum \text{non touching loops}$$

$$\begin{aligned} &= 1 + G_1 G_2 H_1 + G_4 H_3 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_4 \\ &+ G_1 G_6 G_3 G_4 H_4 + G_1 G_6 G_5 H_4 + G_1 G_2 G_4 H_1 H_3 \\ &+ G_2 G_3 G_4 H_2 H_3 \end{aligned}$$

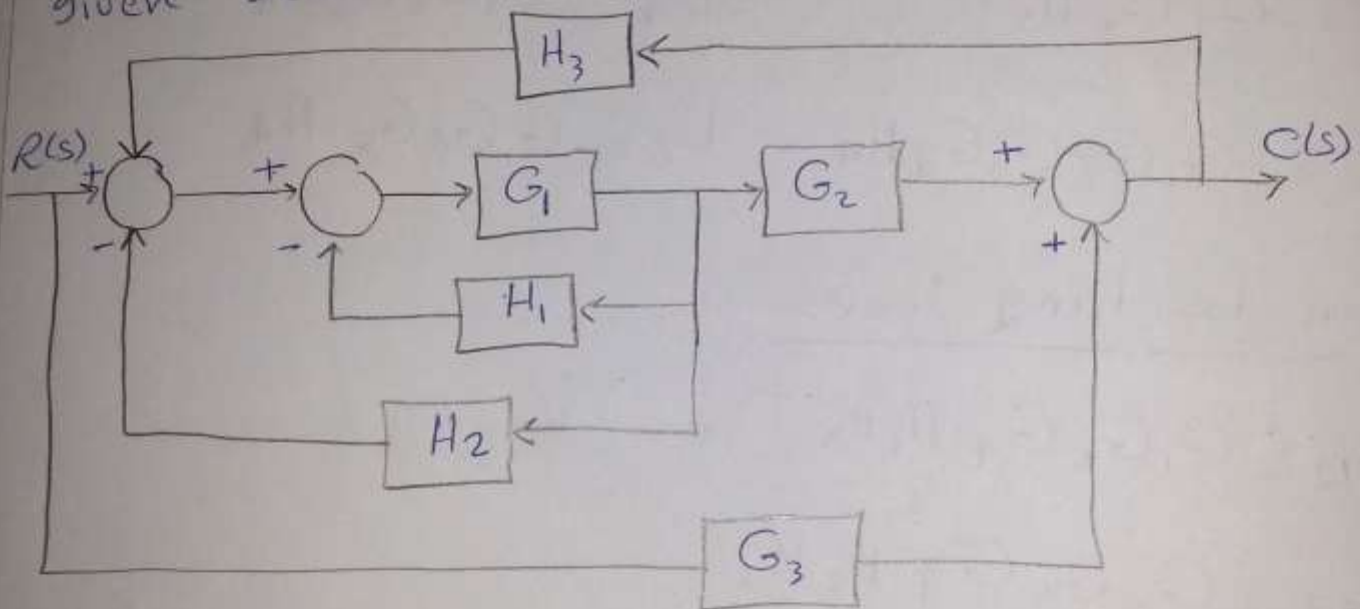
$$\Delta_1 = \Delta|_{P_1=0} = 1 \quad , \quad \Delta_2 = \Delta|_{P_2=0} = 1$$

$$\Delta_3 = 1$$

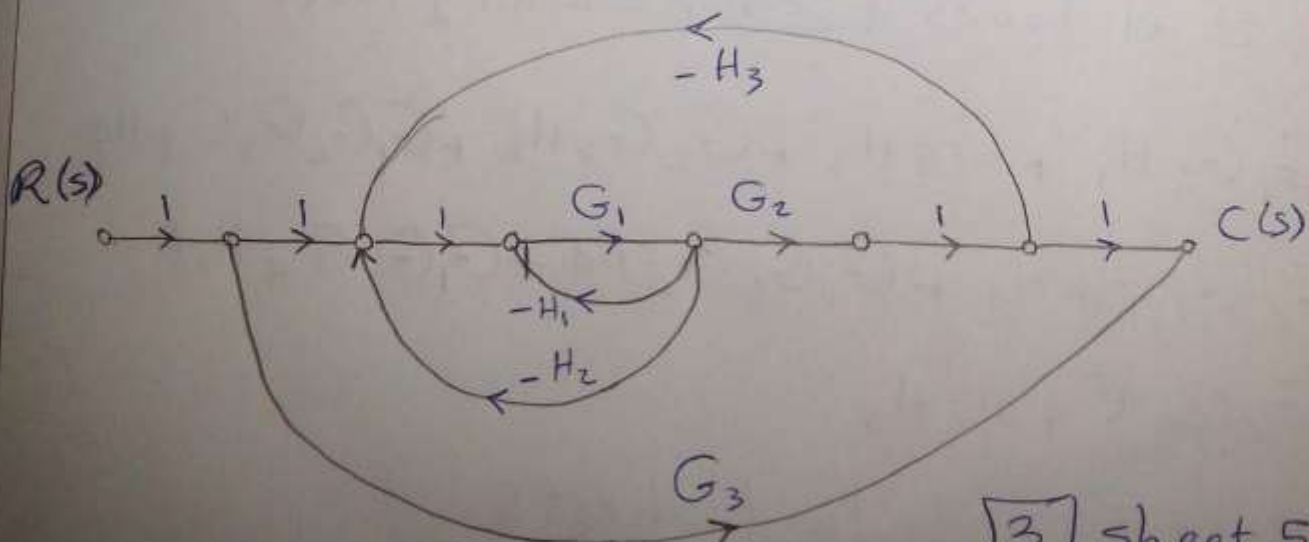
$$\Delta_4 = 1$$

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2 + P_3 \Delta_3 + P_4 \Delta_4}{\Delta}$$

[2] use Mason's signal flow technique to find transfer Function $C(s)/R(s)$ for the block diagram given below:-



[sol]



Forward Paths

$$P_1 = G_1 G_2$$

$$P_2 = G_3$$

Loops

$$L_1 = -G_1 G_2 H_3$$

$$; L_2 = -G_1 H_1$$

$$L_3 = -G_1 H_2$$

→ Non touching loops → = 0

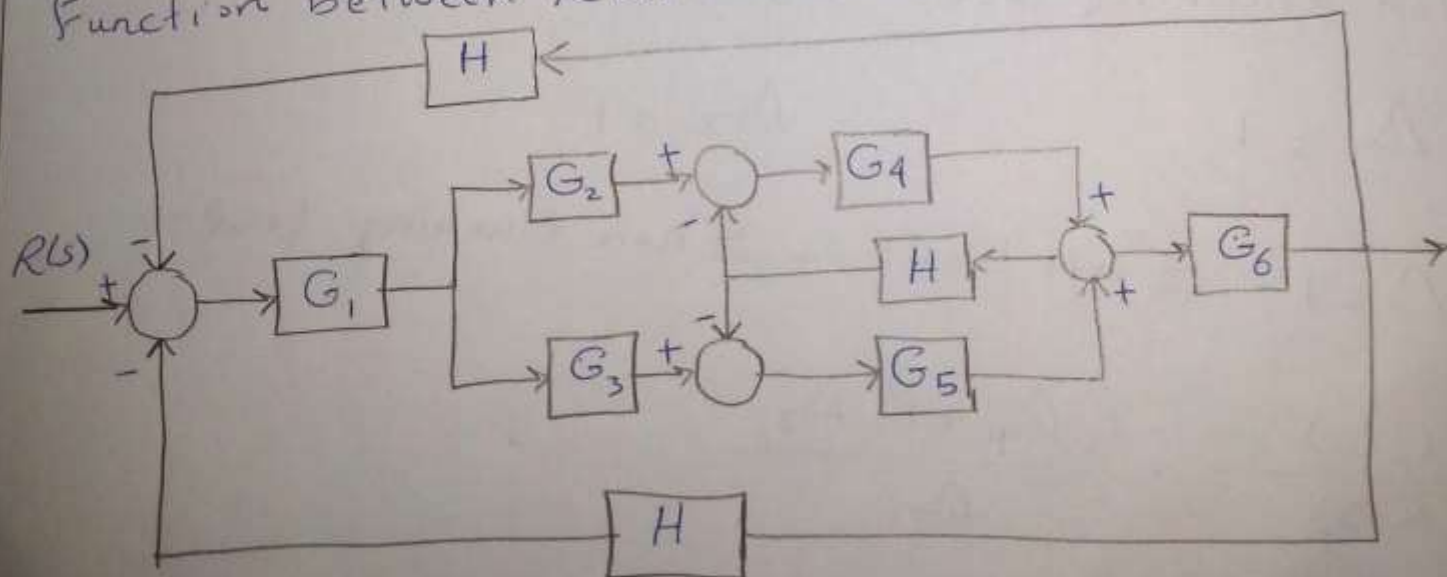
$$\Delta_1 = 1$$

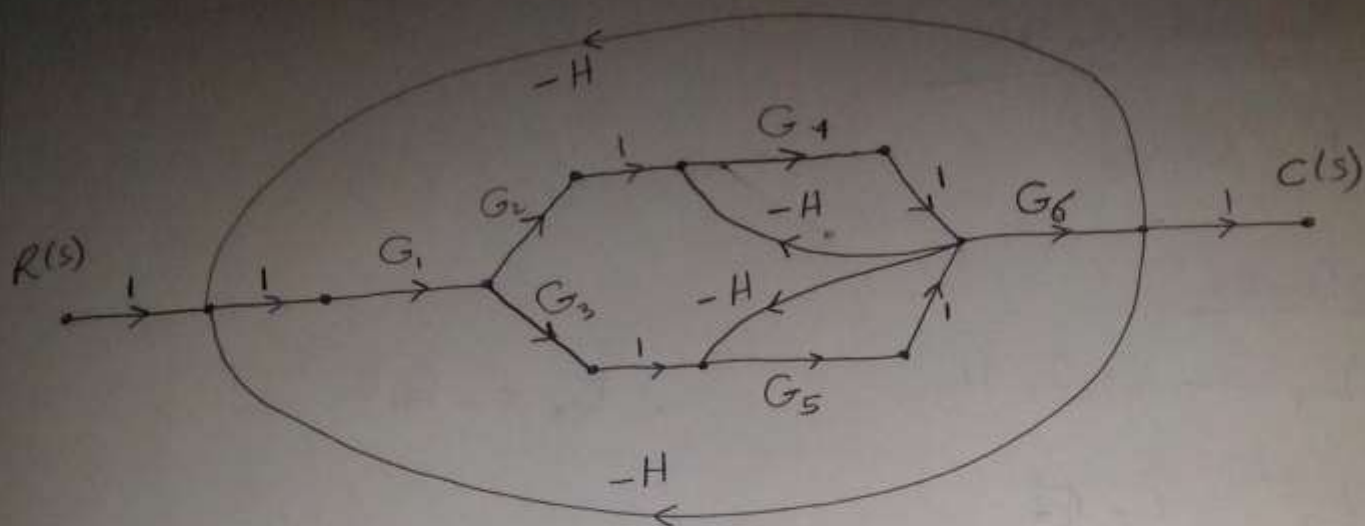
$$\Delta_2 = 1$$

$$\Delta = 1 + G_1 G_2 H_3 + G_1 H_1 + G_1 H_2$$

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2}{\Delta}$$

[3] use Mason's Gain rule to determine the transfer function between $R(s)$ and $C(s)$





Forward Paths

$$P_1 = G_1 G_2 G_4 G_6$$

$$P_2 = G_1 G_3 G_5 G_6$$

Loops

$$L_1 = -G_4 H$$

$$L_2 = -G_5 H$$

$$L_3 = -G_1 G_2 G_4 G_6 H$$

$$L_4 = -G_1 G_3 G_5 G_6 H$$

Non touching loops = 0

$$\Delta_1 = 1$$

$$\Delta_2 = 1$$

$$\Delta = 1 - \sum \text{all loops} + \sum \text{non touching loops}$$

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2}{\Delta}$$